SURFACEVISION

REAL-TIME ELECTRODE INSPECTION & TRACEABILITY

IMPROVED QUALITY CONTROL AND PROCESS OPTIMIZATION FOR CONTINUOUS & INTERMITTENT COATING

APPLICATION NOTE

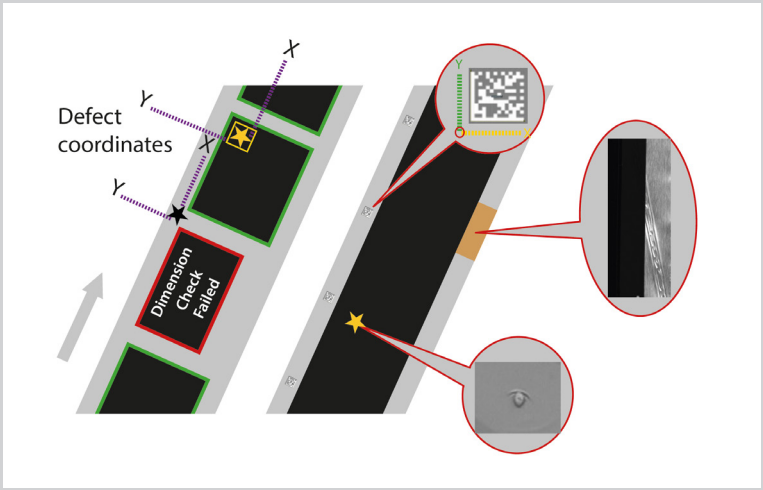
AMETEK®
SURFACE VISION

REAL-TIME ELECTRODE INSPECTION & TRACEABILITY

INTRODUCTION

In the rapidly evolving and highly competitive electric vehicle (EV) industry, battery cell quality and manufacturing efficiency are paramount. To ensure safe and high-quality electrode products, AMETEK® Surface Vision implements high-performing automated online surface inspection systems throughout the entire production process allowing for the identification of surface defects at each step.

Electrode traceability plays a critical role in enhancing both quality and profitability in the manufacturing process of lithium-ion or solid-state battery cells. Surface quality information is tracked at every process step until the finished product using fiducial markers. Easily accessible inspection information, integrated into existing Manufacturing Execution System (MES) systems, allows for utmost transparency and helps process engineers analyze the root cause of product quality deviations



SmartView® Features

- Defect Identification
- Dimension & Alignment Check
- On- / Off-Product Quality
- Quality Traceability

ONLINE SURFACE INSPECTION

Our surface inspection systems have been created to detect and classify surface defects in real-time, ensuring battery cell manufacturers can distinguish non-quality-related optical defects from genuine defects leading to better profitability and higher-quality batteries. The SmartView® surface inspection system continuously monitors electrodes traversing the production line correlating detected defects with the electrode's unique identification markers read by the system.

The system captures detailed information about each defect, including type and precise location. This data is logged in the MES alongside the corresponding electrode's identification marker, enhancing traceability.

Utilizing the detailed inspection data, a recipe-driven automated decision process grades electrodes, routing them for rejection if required, thus ensuring only quality products proceed. As electrodes are assembled into cells, their unique identifiers and associated quality data are tracked through each stage of the process. When the assembled battery cells undergo final testing, their performance data is linked to the electrode identifiers, ensuring traceability by SmartView® from raw materials to the singulation process.

SMART VIEW®

Online detection, classification, and visualization of surface defects

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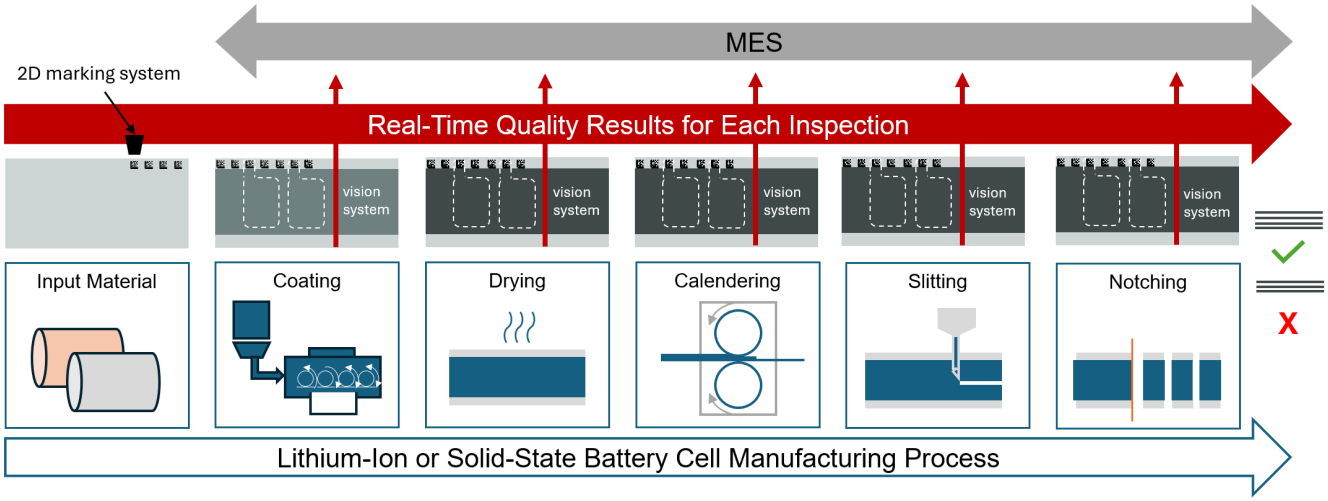
REAL-TIME ELECTRODE INSPECTION & TRACEABILITY

PRODUCT TRACEABILITY WITH FIDUCIAL MARKERS

Fiducial markers can encode a large amount of data in a small area, making it highly efficient for various applications, including product identification, tracking, and traceability.

There are two main electrode marking techniques applied today, laser marking and inkjet printing.

Laser technology can be used to engrave reference codes for unique identification directly onto electrode surfaces, whereas the inkjet printing method can print unique codes onto electrodes using specialized inks that withstand the battery assembly process.



Key Components for Quality Traceability

- **Marking System (laser or ink)**
- **High-Resolution Camera or Sensor**
- **Lighting Solution**
- **Machine Learning Algorithms**

The integration with unique marking codes is a smart addition. By converting defect data from inspection coordinates into fiducial coordinates, the AMETEK® online inspection system ensures synchronization across multiple process lines, which is crucial for associating each detected defect with the correct electrode identifier. This integration streamlines the inspection process and enhances data accuracy.

High-Resolution Cameras in combination with the right lighting solution are essential for capturing detailed images of electrode surfaces. High-resolution cameras ensure that even minor defects are detected accurately, enabling thorough inspection.

Machine Learning Algorithms play a crucial role in analyzing the visual data captured by the cameras. By leveraging machine learning, the system can detect defects with high accuracy and classify them based on their severity and type. The ability to recognize various defect patterns specific to battery electrodes is especially valuable for effective inspection.

Overall, the combination of these key components forms a robust online surface inspection system capable of detecting and classifying defects in battery electrodes efficiently and accurately.

INTEGRATION WITH MANUFACTURING EXECUTION SYSTEMS

We create a digital record for each electrode including defect information for each product synchronized along the different process steps. This allows for precise tracking of quality issues and facilitates targeted corrective actions from coating to the notching process.

Easily accessible inspection information, integrated into existing MES systems, allows for utmost transparency, and helps process engineers to analyze the root cause of product quality deviations.

SURFACEVISION

ABOUT AMETEK SURFACE VISION

AMETEK Surface Vision is the world leader in automated online surface inspection and monitoring solutions. Our broad product range is optimized for the monitoring and inspection of webs and surfaces, and for process surveillance applications.

The SmartView and SmartAdvisor® product lines deliver robust, flexible solutions to continuous production processes across a number of industries, with hundreds of customers and more than 3,000 installations worldwide.

Our systems have become vital to increasing efficiency, streamlining operations, improving product quality and reducing costs and waste in industrial processes. Manufacturers in the metals, paper, plastics and nonwovens industries rely on our solutions to detect surface flaws or defects, and optimize process efficiency, at their production facilities across the globe.

We continue to innovate, providing cutting-edge technologies and world-class technical support that delivers highly accurate defect data, high-definition video, intelligent grading, archiving and detailed reporting. Customers who use AMETEK Surface Vision's services get the benefits of:

- **Reduced operational costs**
- **Process optimization**
- **Reduced process upsets (breaks, wash-ups, and more)**
- **Improved product quality**
- **Maximized yield**
- **More thorough and objective grading of material**
- **Detection, classification, and visualization of defects**
- **Minimized need for manual inspections**
- **Inspection reports you need, in a form you can use**

Based in Newark, Delaware, AMETEK Surface Vision has offices and sales representatives around the world.
We are part of the Process and Analytical Instruments Division of AMETEK, Inc., a leading global manufacturer of electronic instruments and electromechanical devices.

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